European Journal of Physical Education and Sport Science
ISSN: 2501 - 1235
ISSN-L: 2501 - 1235
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.1050405

Volume 3 | Issue 12 | 2017

EFFECTS OF WHOLE-BODY VIBRATION OVER DELAYED-ONSET MUSCLE SORENESS IN PHYSICAL ACTIVE PERSONS

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Abstract:
The aim of this study was to investigate the effects of vibratory platform upon delayed-onset muscle soreness in physically active persons. 24 volunteers were recruited and randomly divided in 3 different groups: control, vibratory platform before exercise, vibratory platform after exercise. Volunteers were submitted to physical training to induce muscle pain. Pain sensation and muscular flexibility were valued in 3 consecutive days. Vibratory platform was able to reduce significantly muscle pain in both platform groups and there were no changes in muscular flexibility in any group.

Keywords: vibratory platform, DOMS, WBV, flexibility

1. Introduction

Muscle pain can be very disturbing and endure to an important disability in athletes. Delayed-onset muscle soreness (DOMS) caused by exercise use to appear between 24-48 hours after training and use to last between 5-7 days [1]. For many athletes this time can compromise their campaign and good results. Lots of muscular recovery strategies have been utilized to minimize pain symptom in physical training [2].

Normally, DOMS can be evidenced by muscular flexibility and strength and the gold standard treatment consist in rest, ice, anti-inflammatory drugs, therapeutic ultrasonic, electrical stimulation, massage and vibratory platform therapy [1].

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During the last decade, a new treatment based on application of mechanical waves, called whole-body vibration WBV, was introduced to increase muscular ability to generate forces in human body [3-5]. WBV activate muscles mechanically through reflex response [6, 7].

Knowing that Whole-body vibration (WBV) increases muscle function, is possible to think that this therapy could be effective preventing muscle injuries once it increases motor unit synchronization reducing miofibrilar stress during exercise in eccentric contraction. Actually, WBV has been suggested to solve this problem [8]. Scientific evidences that ensure benefit effects of WBV over muscular affections are still skimp.

In 2007, a study of Bakhtiary investigated the benefit effects of vibratory platform applied before physical training to reduce effects of DOMS in sedentary individuals. They found a significant reduction in muscle pain and suggest that more similar studies need to be done in athletes due to their different muscular condition [9].

Another study written by Atefh (2012) investigated the effects of vibratory platform applied before exercise training to reduce effects of DOMS in sedentary persons. The results were positive for their hypothesis and they suggest that more similar studies need to be done with athletes and physical active persons to compare the effects in a different muscular condition [10].

Atefh developed another study where they investigated WBV efficiency, applied before exercise training, over DOMS in sedentary individuals. They found a reduction in Creatine Kinase levels and muscle pain although they haven't found any changes in muscle flexibility. Based on this findings, is recommended to reproduce this kind of study in athletes because there are no studies with this public [11].

A study written by Wheeler and Jacobson (2013) investigated vibratory platform effects over DOMS induced by two different kind of training: high and low intensity. DOMS was induced in sedentary young people and they were divided in control group and WBV after exercise group. They valued the effects of DOMS over muscular flexibility of hamstrings and muscle pain using a visual analog pain scale. The measures were taken immediately after WBV in four consecutive days. As result, they found that WBV is effective over DOMS and muscular flexibility in both cases: high and low intensity exercises [12].

A study written by Rhea (2009) investigated the effects of vibratory platform applied after exercise training in sedentary individuals and they found significant relieve of DOMS symptoms predicating this treatment as an efficient method to reduce DOMS [1].

This study intends to promote a new propose of treatment to a very common affection, using a tool that is well expanded on market being accessible to a plant of persons: the vibratory platform. WBV has the benefit of not be an invasive procedure, no pain, low cost and have other certificate scientifically positive effects like increase of bone tissue, increase of muscle strength and increase of performance. Beyond, it has a lot of uses and benefits in sports like maximization of muscle performance, improvement of neuromuscular respond and aerobic capability [13-20].

WBV was well studied in sedentary persons. On the other hand, literature suggests that another public with different muscular condition, like athletes and physical active persons, may present dissimilar responses [11].

1.1 Objective

The aim of this study was to determinate WBV efficacy over DOMS in physical active persons assessing perception of pain and muscular flexibility.

2. Methodology

2.1 Volunteers

24 adult individuals were recruited to this study. They were all physical active persons and used to work out 5 hours per week during the last 6 months before this study at least. They couldn't take any medicament or alimentary supply during this study and the week before it. They were randomly distributed in one of the three groups: WBV before exercise training, WBV after exercise training and control group. Each group was composed for 8 persons.

3. Admission and exclusion criteria

The volunteers were admitted when:

1. They were physical active persons: at least 5 hours per week.
2. They should have been working out on the last 6 months before this study.

The volunteers were excluded when:

1. Use of vibratory platform where no indicated as tumors, circulatory system alterations, cardiac affections, joint prosthesis, diabetes, epilepsy, arthritis, irregular period or pregnancy.
2. Historic of chirurgic intervention on the last 12 months before this study that lead to some diary life incapability.
3. Historic of neurologic disease.

3.1 Control group

This group didn't receive WBV but did the physical training. Muscular flexibility and pain perception measures were taken.

3.2 WBV before exercise group (WBVB)

This group received WBV before physical training. Muscular flexibility and pain perception measures were taken.

3.3 WBV after exercise training group (WBVA)

This group received WBV after strength training. Muscular flexibility and pain perception measures were taken.

3.4 Data collect

Data collect were made in three days. There was 24 hour between each section.

- Day 1: physical training, WBV (before or after exercise training depending on each group), goniometry and pain assessment.
- Day 2: goniometry and pain assessment (24 hours after exercise training).
- Day 3: goniometry and pain assessment (48 hours after exercise training).

3.5 Pain assessment

To assess pain a visual analog scale of pain perception was utilized (EVA). Volunteers indicated a numeric value to their pain in the scale where 0,0 means no pain and 10,0 means unsupportable pain. This scale was utilized in all three groups.

3.6 Muscular flexibility

To assess muscular flexibility of hamstrings were adopted the goniometry to the hips flexion, as suggested by Wheeler [12, 21]. The chosen goniometer was COMED 360º plastic model, 30 centimeters. The adopted posture to measure hips flexion was supine tumbled upon a litter. The evaluator realized a passive flexion of the hips while volunteers kept a total knee extension (180º starting from anatomic position). The circular disc was situated upon femur's trochanter mayor, fixed arm was parallel to the ground and distal arm was aligned to femur's lateral line.

The opposite leg was kept in neutral position (extended). The goniometry was applied only in the dominant leg and was used in all three groups.

3.7 Physical training

To induce fatigue and pain of muscles we utilized isometric squat exercise with support of the back in the wall. Volunteers were positioned keeping their hips and back in the wall and knee bended in 90º. Their hands were resting in the hips to avoid bad compensations in posture as can be seeing on figure 1. The posture was maintained for the maximal time that volunteers could support and this exercise was repeated 3 times in all three groups.

Figure 1: Positioning of the isometric squat

3.8 Whole body vibration (WBV)

Volunteers stand on vibratory platform keeping the parallel position of their feet and opened width to the shoulders. Knees were 60º bended (squat position). They were only wearing socks to avoid some interference of different kind of shoes and facilitate the transmission of the mechanical waves (figure 2). We applied a vibration of 35Hz and 5mm of oscillation amplitude during 60 seconds. This training was not applied on control group.

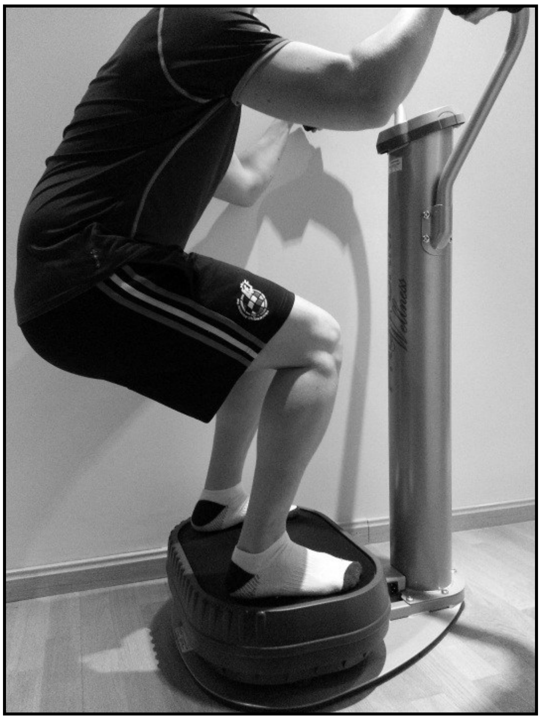

Figure 2: Positioning over the platform

3.9 Statistical analysis

Statistic was calculated using SPSS program for window, version 17.0 (SPSS Inc., USA). On the first descriptive statistic, we've calculated averages and typical deviations of muscular flexibility and pain variables for each group for the three days of assessment. Latter, we calculated an interferential statistic using Kolmogorov-Smornov test to verify the conditions of normality and, how this conditions were always satisfied, we used parametric tests: ANOVA repetitive standard to know the existence of significant differences among several models with paired data (time variable) and several models with paired data (group variable). The results were considered significant when signification grade was less than 0,05 ($p < 0{,}05$).

4. Results

About muscular flexibility of hamstrings on the first day, WBVB group got medium average of 81,63 ± 14,18º. WBVA presented a medium average of 88,37 ± 9,91º and control group 88,12 ± 17,41º. There were no significant differences among three groups. Typical averages and deviations of muscular flexibility during three days can be seen on table 1.

Table 1: Muscle flexibility

	WBVB group (average ± typical deviation)	**WBVA group** (average ± typical deviation)	**Control group** (average ± typical deviation)
First day	81,63 ± 14,18º	88,37 ± 9,91º	88,12 ± 17,41º
Second day	83,87 ± 12,46º	86,87 ± 11,58º	84,25 ± 16,76º
Third day	85,12 ± 10,77º	88,87 ± 13,22º	84,50 ± 17,28º

ANOVA of repetitive standard have shown that time and group variables were significant. About muscle pain, typical average and deviations of the three groups can be founded on table 5.2. Significant differences founded, to both variables time and group, can also be seen on table 2.

Table 2: Muscle pain

	WBVB group (average ± typical deviation)	**WBVA group** (average ± typical deviation)	**Control group** (average ± typical deviation)
First day	$4,83 \pm 2,04^{a,b,*}$	$4,83 \pm 0,41^{a,b,\#}$	$7,17 \pm 1,60^{a,b,*,\#}$
Second day	$1,00 \pm 0,89^{a}$	$1,50 \pm 0,84^{a,c}$	$2,17 \pm 1,33^{a}$
Third day	$0,83 \pm 0,98^{b}$	$0,00 \pm 0,00^{b,c,\#}$	$1,17 \pm 0,98^{b,\#}$

a: significant differences between first and second days at the same group (p<0,05);
b: significant differences between first and third days at the same group (p<0,05);
c: significant differences between second and third days at the same group (p<0,05);
*: significant differences between WBVB and control groups at the same day (p<0,05);
#: significant differences between WBVA and control group at the same day (p<0,05).

ANOVA of repetitive standard have shown that both effects of variables time and group were significant. Pain was more significant on the first day than the second and third, analyzing variable time wherever the group. In WBVA group, pain was also higher on the first day than second and third. Maximum values of pain were founded on the first day. Analyzing variable group, pain was significant minor in WBVB and WBVA than control group on the first day, and was significant minor in WBVA than control group on the third day.

5. Discussion

On the last years, the scientific literature has been studying the effects of vibratory platform as a method to reduce DOMS in sedentary persons. The aim of this study was to determine the effects of WBV over DOMS in physical active persons once that a different muscular condition would present different responses.

There were no significant differences in muscular flexibility of hamstrings to variable group that means DOMS did not affect this variable. This result is in agreement with Wheeler and Jacobson (2013) that did not find significant changes on flexibility in 20 sedentary students after strength training [12]. Gerodimos 2010 found significant differences on muscular flexibility in sedentary persons applying WBV after exercise (squat with associated jumps) [23].

The only article that studied the increase of flexibility in athletes was written by Cochrane and Stannard (2005). All 18 selected female athletes were hockey players and their physical training was ergometer cycling followed by vibratory platform intervention. In this study was found an increase of muscular flexibility compared to control group [22].

In our study, the results look to indicate that flexibility of hamstrings was not affected by strength training, independent of the protocol, the use of vibratory platform could not increase flexibility because it was not affected.

According with vibratory platform effects over muscular flexibility there are no conclusive results. Several studies do not coincide among them due to very different applied methodologies, volunteers, parameters of vibratory platform uses and kind of training. Methodologies have varied a lot using isokinetic dynamometer training, ergometer cycling, isometric squats and stretching sessions. Volunteers did not vary too much among the studies being sedentary young persons and only one of them with athletes. The vibratory platform parameters had varied a lot: frequency of vibration (25-50Hz), amplitude of vibration (2-5mm) and time (between 30 seconds and 6 minutes). All this variety in methodology can explain the difference between the results among the studies.

We found significant difference in muscle pain to both time and group varieties. The main difference found in physical active individuals was that maximum pain occurred right after the exercise training and disappears in 48 hours. In sedentary individuals the pain used to appear 24-48 hours after exercise and prolongs in time [1, 9, 10-12, 21]. In our study the pain was significantly higher in the first day than second and third in all groups and higher ($p < 0,01$) and on the second day than third for WBVA ($p < 0,01$).

The possibility that the sedentary muscle fiber could suffer more injuries than physical active persons, due to its low conditioning, could explain the higher pain sensation, its extension in time and the fact that maximum pain occurred at the end of exercise training. Another possibility is that volunteers could not get into their maximum effort during the exercise training and it could be not enough to generate an extended pain sensation.

In group variable, the measures of the first day, control group felt a significant higher pain ($p < 0,05$) than the other two groups. These results are in agreement with literature [1, 9-12].

Atefeh selected 32 sedentary individuals and investigated the effects of vibratory platform over DOMS before an eccentric strength training using an isokinetic dynamometer. The results shown a significant reduction in DOMS, leading them to conclude that vibratory platform is a good method to reduce pain sensation, related to exercise, when it's used before exercise training [10]. A Wheeler and Jacobson study have valued muscle pain sensation in 20 students during four days after physical training. WBV was used before the exercise and pain sensation was valued using an analog scale (EVA) [12]. As result, they found a significant reduction of DOMS. A study developed by Rhea tried to find out DOMS reduction in 16 sedentary individuals applying WBV after physical training [1]. They also suggest WBV as a good method to reduce DOMS symptoms at the same day of physical training. Bakhtiary studied vibratory platform benefits in 50 sedentary individuals after a treadmill physical training and they found an important reduction in DOMs symptoms in WBV group compared to control group. They suggest similar studies with athletes [9].

Methodologies were too distant among the studies but all of then found reduction of DOMS using WBV before and after physical training in sedentary persons.

On the second day, all three groups felt minor pain sensation than the first day and we haven't found any significant difference among three groups, although the highest pain was felt on control group. Analyzing third day, significant difference ($p < 0,05$) was notice between WBVA and control group, but not between WBVB and control group (but control felt more pain than WBV). It seems to indicate that significant differences would be found on second day between WBVA and control group and between WBVB and control. The same would have happened on the third day between WBVTB and control group if we would have a mayor sample. Our results also seems to indicate that WBV after physical training have better results in DOMS symptoms than used before.

6. Conclusions

Use of vibratory platform, applied before and after physical training, is an effective tool to reduce any DOMS symptom induced by physical training in sedentary and physical active persons. According this study, WBV after exercise seems to be more effective.

DOMS did not appear in physical active persons like sedentary. In our study maximum pain were found on the first day right after physical training. New investigations need to be developed with a mayor sample, as repetitive standard studies extended in time. Would be interesting to investigate athletes of different patterns and distinguish WBV in different sports.

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